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A Review of GSM based Automated Water Deployment System for Irrigation using Wireless Sensor Network & Android mobile

N. D. Kuchekar, Prof. R. A. Pagare

Abstract— the irrigation based modern agriculture is the recent requirement in every part of agriculture in India. With developments in technology, efforts are being channeled into automation of irrigation systems to facilitate remote control of the irrigation system and optimize crop production and cost effectiveness. This paper demonstrates how an automatedd water deployment system (AWDS) can practically be proposed by Wireless sensor network (WSN) which consists of Wireless sensor unit (WSU) & Wireless information unit (WIU). Specifically it will be developed to minimize water use for agriculture crops. The proposed system ensures that water is distributed to field properly. The system incorporated a remote monitoring mechanism via a Global system for mobile communication (GSM) module to report soil temperature, soil moisture & humidity. In the irrigation area automatic system, high performance embedded micro-controller and low-power technology is used to design the wireless sensor network. The wireless network is placed in the root zone of the plants for real time infield sensing & control of an irrigation system. In addition, WIU unit handles sensor information and transmit data to a android smart phone. It is observed that first time for the first time an android app inventor used in the irrigation syatem. The objective of the work is to provide an approach that helps farmers to easily access, manage and regulate their irrigation systems for the water needs of crops.

Index Terms— GSM module (mobile), Android, SMS,Wireless Sensor Network, automatic irrigation, Zigbee, sensors, microcontroller, regulated power supply.

I. INTRODUCTION

The Irrigation is the artificial application of water to the soil for assisting in growing crops. It minimizes the use of water & fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone due to which a large quantity of water is saved & also the fertilizer which comes to the plant with the water. In agriculture, various parameters including soil type and temperature vary dramatically from one region to the other and therefore any irrigation system must be flexible. [3].

Agriculture uses freshwater resources worldwide, which is dependent on the monsoons, and it is not a reliable source of water, so there is an urgent need for water deployment system to sustain use of water & provide water to the farms according to their moisture, temperature and soil types & fertilizers. [3]

In this project, a wireless sensor network based intelligent system is proposed and then applied for monitoring of soil, temperature & humidity. The motivation of developing this system came from the countries where economy is depends on agriculture and the climatic conditions lead to lack of rains. The farmers working in the farm lands are dependent on the rains and bore wells.

The network consists of sensing stations & a weather station. Each of the sensing station contained data logger, a soil temperature sensor & zigbee communication. The development of WSN based on microcontrollers & communication technolo gies can improve the current methods of monitoring to support the response in real time. The aim of implementation will to demonstrate that the water deployment system can be used to reduce water use. The soil moisture & temperature sensors deployed in plant root zones. The sensor measurements are transmitted to a microcontroller based receiver. This gateway permits the automated activation of irrigation when the threshold values of soil moisture & temperature are reached. The communication between the sensor nodes & data receiver is via Zigbee protocol. Zigbee is the new wireless technology it uses 2.4 GHz frequency band with having IEEE 802.15.4a protocol.When we are receiving this information from the wireless sensor network we want to monitor the parametrs & control this parameter wirelessly form remote station. The internet connection allows the data inspection in real time on a website, where soil moisture & temperature levels are displayed. [1],[4].

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II. DESIGN & IMPLEMENTAION

Automated Water Deployment system And System Description

Fig.1 shows Configuration of the Automated Water Deployment system, i.e. the whole system architecture, which consists of two components, wireless sensor units (WSUs) and a wireless information unit (WIU), and linked by radio transceivers that allowed the transfer of soil moisture and temperature data, implementing a WSN that uses ZigBee technology. The WIU has also a GSM module to transmit the data to a smart phone via the public mobile network. The information can be remotely monitored through Internet access devices. [1].

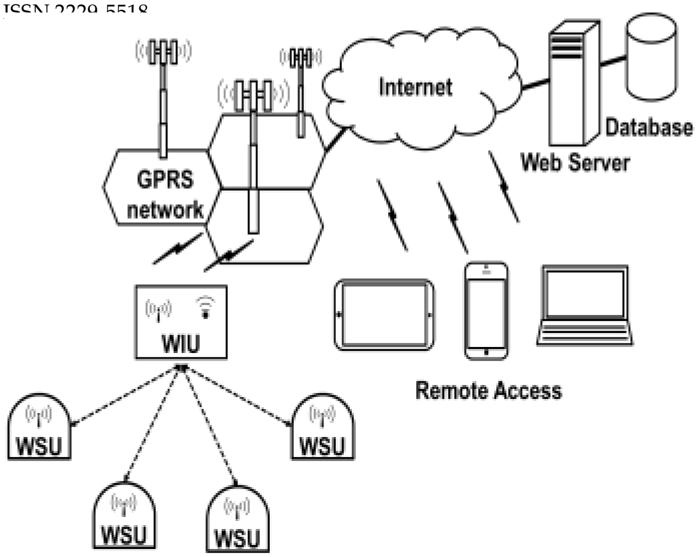

FIG 2.1: Configuration of the Automated Water Deployment system.

- **HARDWARE DESIGN OF WSU**

A. Wireless Sensor Unit:

A WSU is comprised of a RF transceiver, sensors, a microcontroller, and power sources. Several WSUs can be deployed in-field to configure a distributed sensor network for the automated water deployment irrigation system. Each unit is based on the microcontroller PIC16F877 that controls the radio modem ZigBee and processes information from the soil-moisture sensor and the temperature sensor. These components were selected to minimize the power consumption for the proposed application. [4]

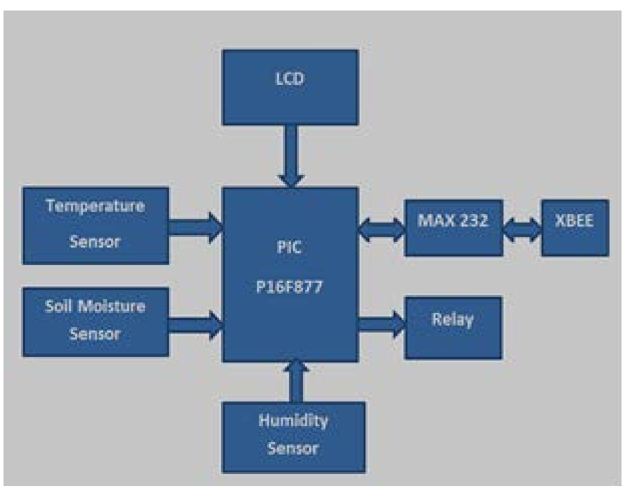

FIG 2.2: Block diagram of the Wireless Sensor Unit

1. PIC16F877 Microcontroller**:**

8-bit microcontroller with 40-pins flash microcontroller that operate in a range 2.0 to 5.5 V. It has high performance RISC CPU, interrupt capability, direct, indirect and relative addressing modes, 8K flash Program Memory,368 bytes of data Memory (RAM), 256 EEPROM data Memory, Programmable code protection, power saving sleep mode, 8-bit analog to digital converters (ADC), serial peripheral interface modules, USRT, 3 timers & 5 ports.The microcontroller is well suited for this remote application, because of its low-power consumption, high speed, power on reset facility, in circuit programming & debugging. [1].

2. Zigbee Modules :

ZigBee (over IEEE 802.15.4) technology is based on short range WSN and it was selected for this sensor network because of its low cost, low power consumption, and greater useful range in comparison with other wireless technologies. The ZigBee devices operate in industrial, scientific, and medical 2.4-GHz radio band and allow the operation in a networking architecture. From a wide range of commercial ZigBee devices, the ZigBee-PRO is an appropriate original equipment manufacturer module to establish communication between a WSU and the WIU because of its long-range operation and reliability of the sensor networking architecture. [1], [4].

3. Soil Moisture Sensor :

Soil moisture sensor is a sensor connected to an irrigation system controller that measures soil moisture content in the active root zone. It is used to measure volumetric content of soil & measure the loss of moisture over time due to evaporation & plant uptake. [4].

4. Humidity Sensor SY-HS-220 :

This sensor module converts relative humidity (30-90 % RH) to voltage & can be used in weather monitoring application. It has high accuracy, rated voltage is 5.0v DC, current consumption is less than 3.0 ma, operating humidity range (30-90 % RH) & standard output voltage is DC 1.980mv.This sensor is suitable for this remote application because of its high accuracy, less current consumption, high operating temperature and humidity range. [1].

5. Temperature Sensor LM 35 :

LM35 Series are precision integrated temperature sensors, with an output voltage linearly proportional to the centigrade temperature. It does not require any external calibration or trimming to provide typical accuracies. It has low cost, low output impedance, linear output, precise inherent calibration, linear scale factor, suitable for remote application.it operates from 4 to 30V, rated for -55°C to 150°C range, require less than 60μA drain current, low self-heating 0.08°C in still air & low output impedance 0.1Ω for 1ma load. [1]

- **HARDWARE DESIGN OF WIU**

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B. Wireless Information Unit:

The soil moisture and temperature data from each WSU are received, identified, recorded, and analyzed in the WIU. The WIU consists of a master microcontroller ARM7 LPC2138, a Zigbee radio modem, a GSM module SIM900, an RS-232 interface. The WIU can be located up to 100-m line-of-sight from the WSUs placed in the field. All the WIU processes can be monitored through the RS-232 port. The WIU includes a function that synchronizes the WSUs at noon for monitoring the status of each WSU. [1]

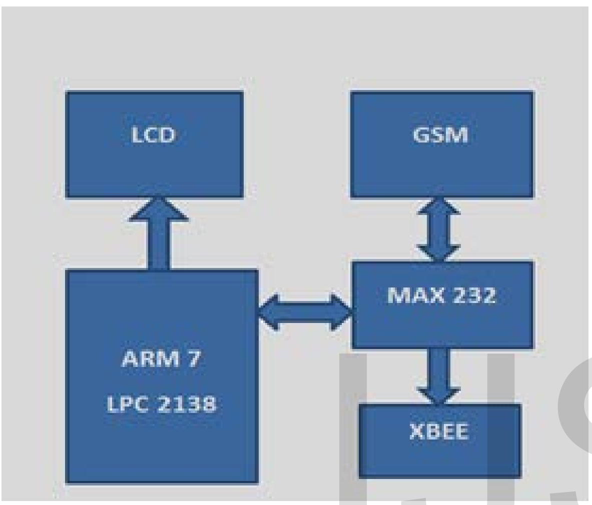

FIG 2.3: Block diagram of the Wireless Information Unit.

1. Master Microcontroller ARM7LPC 2138:

ARM7 LPC 2138 designed to enable easy development of real time applications, testing & monitoring of various solutions. The LPC 2138 μC are based on a 32/16 bit ARM7 TDMI CPU with real time emulation & embedded trace support, that combines the μC with 32 KB, 64 KB & 512 Kb of embedded high speed flash memory. Due to their tiny size & low power consumption this μC are ideal for this application. [2].

2. GSM Module SIM900:

The SIM900 is a complete quad band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. It can communicate with controllers via AT commands. This module support software power on & reset. It is designed with a very powerful single chip processor & it has low power consumption. [3].

- **WORKING**

The system works in two parts:

1) Transmitter 2) Receiver

Transmitter:

Initially when power is on, signals are read by different sensors like temperature, humidity, soil moisture and its output is given to microcontroller. Output of microcontroller from sensors is taken through ADC pins and then it is given to zigbee module through Rx & Tx pins. Then it will transmit these data wirelessly to the receiver side. [4].

Receiver:

At receiver side both GSM & zigbee come into picture. The data transmitted by transmitter are received at the receiver & it will display the parameter. It is possible to made no. of slave unit. In this proposed project, I will implement two slave units. At the receiver both slave units parameter will be displayed. Then these parameters are transmitted to smart phone by using GSM module. This is how total working will takes place of automated water deployment system. [4].

III. SIMULATION

Proteus is one of the most famous simulators will be used in this project. It can be used to simulate almost every circuit on electrical fields. It is easy to use because of the GUI interface. Proteus PCB design combines the ISIS 7.7 SP2 with advanced simulation schematic capture and ARES PCB layout programs to provide a powerful, integrated and easy to use suite of tools for professional PCB. It is a handy tool to test programs & embedded design.

IRRIGATION ACTION-1

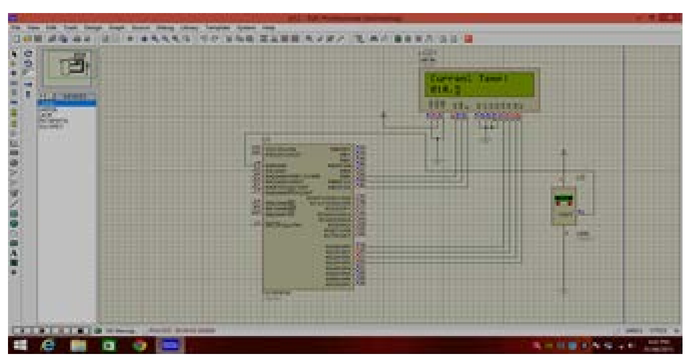

Fig 3.1 ISIS Schematic view of IA-1

Proteus is used as simulation tool. The ISIS schematic view of irrigation action-1 is shown in Fig 3.1. The LM 35 will sense the temperature at the root zone of the plant continuously. The

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temperature value shown in fig is 10.5°C.

The ISIS schematic view of power supply & serial communication used is shown in Fig 3.2:

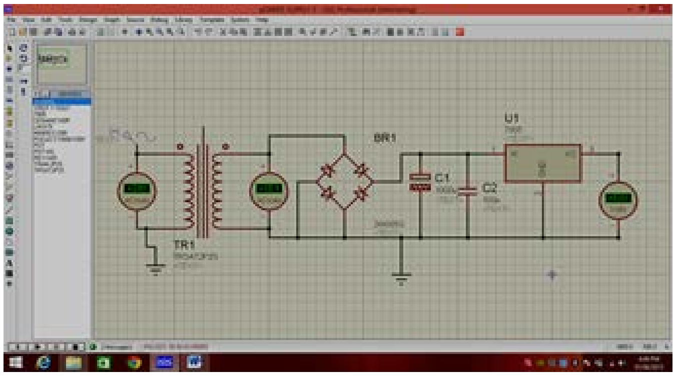

Fig 3.2 ISIS Schematic view of power supply

IV. SOFTWARE IMPLEMENTATION

MPLAB X IDE software used for coding of PIC microcontroller because it supports editing, debugging & programming of microchip 8 bit, 16 bit & 32 bit PIC microcontrollers. It is used in this proposed project because it supports multiple configuration, multiple debug tools, hyperlinks for fast navigating & live code templates.
The programming in C language that will convert in assembly language program using Keil µVision4 compiler. It is basically used for coding of ARM7 microcontroller.

ALGORITHM

- For slave unit 1 & 2:

Step1: start the process.
Step2: Initialization of port pin, LCD, zigbee.
Step3: Read temperature, humidity & moisture.
Step4: If request from master comes then send tem perature, humidity & moisture.
Step5: Go to step 3
Step6: stop the process.

- For Master unit:

Step1: start the process.
Step2: Initialize LCD, GSM, and zigbee.
Step3: After 5 seconds send request to slave unit 1 to get its parameter.
Step4: if slave unit 1 responds to master request, it will send its parameters to master & master will display it.
Step5: After next 5 seconds send request to slave unit 2 to get its parameters.
Step6: if slave unit 2 responds to master request, it will send its parameters to master & master will display it.
Step7: After every 1 minute send parameters of slave 1 and slave 2 to smart phone.
Step8: Go to step 3.
Step9: stop the process.

Program:

```
#include<htc.h>
#define _XTAL_FREQ 4000000
#include"lcd.h"
#include"adc.h"

void main()
 {
            unsigned char i=0;
            unsigned char a[]={"Current Temp:"};

             __delay_ms(100);
    init_lcd();
    __delay_ms(10);

    for(i=0;a[i]!='\0';i++)
    {
     lcd_cmd(a[i],1);
    }
            __delay_ms(10);
            adc_init();
            while(1)
            {
                        adc_read();
            }
```

V. Advantages & Disadvantages

5.1 Advantages

The proposed Automated Water Deployment system will found to be relatively simple to design & install. This system will works according to soil condition; it will be highly sensitive, feasible & reliable circuit. This system will reduce water consumption & operating expenses for irrigation management. It will be safest and saves lot of time of the farmer also work can be carried out quickly. This irrigation system will be adjusted to a variety of specific crop needs & temperature monitoring in compost production can be easily implemented.

5.2 Disadvantages

This proposed system will mostly applicable for only large size farms. It will require frequent maintenance for efficient operation. Sometimes this system will have limited life due to deterioration of the component in a hot, arid climate when exposed to ultraviolet light.

VI. RESULT & DISCUSSION

The proposed work will follow the procedure:
All sensors will determine the moisture level, humidity & temperature at the root zone. Then these data will be wirelessly transmitted to the receiver by using zigbee module.

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These parameters will be received, identified & recorded at the receiver side & then it will be transimitted to the smart phone by using GSM module.

The app inventor is a visual, drag & drop tool for building mobile apps on the android platform. App inventor is used to design the user interface of an app using a web-based graphical user interface builder, and then it specifies the app's behavior by piecing together "blocks". The app is a text "answering machine". The schematic view of an android app created for AWDS is shown in Fig. 6.1.

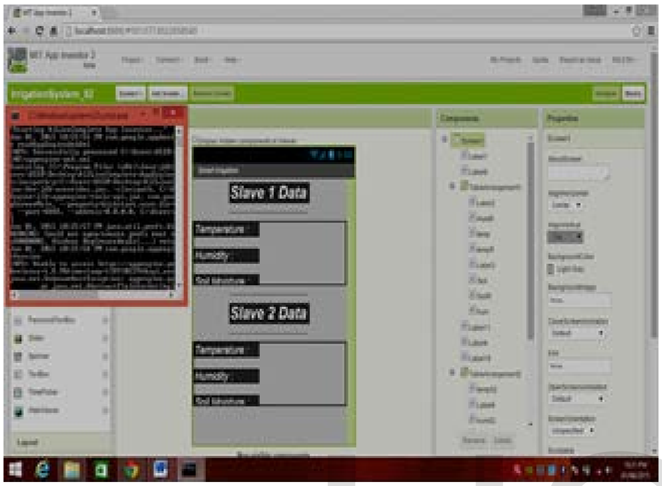

Fig 6.1: APP Inventor Schematic view

VII. CONCLUSION

The proposed automated water deployment system for irrigation will be found to be feasible & cost effective for optimizing water resources for agricultural production. This system has an advantage of using both GSM & zigbee technology which eliminates the cost of network usage to a great extent. By using Zigbee technology it is possible to send as well as receive all the information easily.

The microcontroller based this irrigation system using wireless techniques will monitor the activities of irrigation system efficiently. This application of sensor based irrigation has some advantages such as it saves lot of time of farmer, can be adjusted to variety of specific crop needs & preventing moisture stress of trees.The automated water deployment system will prove that the use of water can be diminished. It will avoid over irrigation, under irrigation & top soil erosion. The proposed system can be used for agricultural, horticultural lands, parks, gardens irrigation. The configuration of the irrigation system allows it to be scaled up for larger greenhouses or open fields.

ACKNOWLEDGMENTS

The goal of this paper is to design "GSM based Automated Water Deployment System for Irrigation using a Wireless Sensor Network & android mobile "The function has been realized successfully. I wish to place on record my sincere thanks and whole hearted thanks to my guide Prof. Pagare R. A. under whose supervision this dissertation work has been carried out. It was his keen interest encouraging disposition and full co-operation that has made it possible for me to complete this work. I wish to place on record my sincere thanks and also acknowledge my indebtedness to Prof. Hendre V. S., Head of Electronics & Telecommunication Department, whose critical analysis, careful comments and valuable suggestions have been immense help in completing this work. Lastly, I am thankful to all those persons, who have contributed directly or indirectly in the completion of this project.

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